

J.R. SIMPLOT COMPANY – SMOKY CANYON MINE

STANDARD OPERATING PROCEDURE No. 1

FIELD DOCUMENTATION

1.0 SCOPE AND APPLICABILITY

The following Standard Operating Procedure (SOP) describes the protocol for documenting field activities of environmental monitoring at J.R. Simplot Company's Smoky Canyon Mine.

When this procedure is referenced by a monitoring or sampling and analysis plan, field personnel shall document field activities in the field notebook and on formatted field records or data sheets, as described below. The field notes and formatted records/data sheets will be part of the project file; all records must be filled out carefully and completely by one of the personnel actually performing the field activities.

2.0 BASIS FOR METHODOLOGY

The methods and procedures described in this SOP were developed from ANSI, ASTM and USEPA guidelines (ANSI, 1994; ASTM D 6089; USEPA, 1995).

3.0 PROCEDURES

3.1 Daily Field Activities

The field representative will record all daily field activities in the field notebook for each day of field work. Documentation will include:

- A. Project identification;
- B. Date;
- C. Time on job (beginning and ending time);
- D. Weather conditions;
- E. Activity description;

- F. List of personnel and visitors on site;
- G. Safety equipment used and monitoring performed;
- H. Waste storage inventory (if any);
- I. Chronological record of activities and events;
- J. Comments and variances from project work plan;
- K. Content of telephone conversations; and
- L. Signature of the field representative.

The field representative will document all details that would be necessary to recreate the day's activities and events at a later time. The field notebook will be used to document field activities that may not be specified on other field record forms. Other activity-specific documentation requirements to be recorded are discussed in the Standard Operating Procedure for each activity.

4.0 DOCUMENTATION

4.1 Field Record Forms

In addition to the field notebook, field personnel will complete specific field record forms applicable to the field activities being conducted. The procedures for completion of activity-specific field record forms are presented in the applicable Standard Operating Procedures. Additional field record forms and applicable procedures may be created for project-specific activities, as necessary.

4.2 Records Management

All original field forms will be filed with the appropriate project's records.

5.0 QUALITY ASSURANCE

5.1 Form Review and Filing

All completed field forms will be reviewed by the Project Manager or project designated reviewer. Any necessary corrections will be made in pen with a single-line strike out that is initialed and dated.

6.0 REFERENCES

American National Standards Institute/American Society for Quality Control, 1994. American National Standard Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs. ANSI/ASQC E-4.

ASTM D 6089. Standard Guide for Documenting a Ground-Water Sampling Event. American Society for Testing and Materials available online at <http://www.astm.org/>

U.S. Environmental Protection Agency, 1995. EPA QA/G6, Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality Related Documents. EPA/600/R-96/027. Office of Research and Development, Washington, DC.

U.S. Environmental Protection Agency, 1998. EPA QA/G5, EPA Guidance for Quality Assurance Project Plans. EPA/600/R-98/018. Office of Research and Development, Washington, DC.

J.R. SIMPLOT COMPANY – SMOKY CANYON MINE

STANDARD OPERATING PROCEDURE No. 2

SAMPLE CUSTODY, PACKAGING, AND SHIPMENT

1.0 SCOPE AND APPLICABILITY

The following Standard Operating Procedure (SOP) describes the protocol for sample custody, packaging and shipment of samples collected during environmental monitoring at Smoky Canyon Mine. The procedures presented herein are intended to be general in nature and are applicable when referenced by a monitoring or sampling and analysis plan. If warranted, appropriate revisions may be made when approved in writing by the Project Manager.

This SOP applies to any liquid or solid sample that is being transported by the sampler, a courier or an overnight delivery service.

2.0 BASIS FOR METHODOLOGY

The methods and procedures described in this SOP were developed from these sources:

- 49 CFR 173. Shippers – Shippers – General Requirements for Shipping. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>
- 49 CFR 178. Specifications for Packaging. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>
- ASTM D 4220. Standard Practice for Preserving and Transporting Soil Samples. American Society for Testing and Materials available online at <http://www.astm.org/>
- ASTM D 4840. Standard Practice for Sampling Chain-of-Custody Procedures. American Society for Testing and Materials available online at <http://www.astm.org/>

3.0 PROCEDURES

The objectives of this packaging and shipping SOP are to minimize the potential for sample breakage, leakage or cross contamination; to provide for preservation at the proper temperature; and to provide a clear record of sample custody from collection to analysis.

3.1 Packaging Materials

The following is a list of materials that will be needed to facilitate proper sample packaging:

- Chain-of-Custody Record forms (Figure SOP-2JRS-1 form or similar);
- Coolers (insulated ice chests) or other shipping containers as appropriate to sample type;
- Transparent packaging tape;
- Zip-lock type bags (note: this is used as a generic bag type, not a specific brand name);
- Protective wrapping and packaging material;
- Contained ice (packaged and sealed to prevent leakage when melted) or "Blue Ice"; and
- Chain-of-Custody seals.

3.2 Sample Custody from Field Collection to Laboratory

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody Record and Request for Analysis form (Figure SOP-2JRS-1 form or similar) for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. Information contained on the triplicate, carbonless form will include:

1. Project identification;
2. Date and time of sampling;
3. Sample identification;
4. Sample matrix type;
5. Sample preservation method(s);
6. Number and types of sample containers;
7. Sample hazards (if any);
8. Requested analysis(es);
9. Requested sample turnaround time;
10. Method of shipment;
11. Carrier/waybill number (if any);
12. Signature of sampling personnel;
13. Name of Project Manager;
14. Signature, name and company of the person relinquishing and the person receiving the samples when custody is being transferred;
15. Date and time of sample custody transfer; and
16. Condition of samples upon receipt by laboratory.

The sample collector will cross out any blank space on the Chain-of-Custody Record and Request for Analysis (CC/RA) form below the last sample number listed on the part of the form where samples are listed. The samples will be carefully packaged into shipping containers/ice chests.

The sampling personnel whose signature appears on the CC/RA form is responsible for the custody of a sample from time of sample collection until the custody of the sample is transferred to a designated laboratory, a courier, or to another employee for the purpose of transporting a sample to the designated laboratory. A sample is considered to be in their custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA form under "Relinquished by" and "Received by." Signatures, printed names, company names, and date and time of custody transfer are required. Upon transfer of custody, the sampling personnel who relinquished the samples will retain the third sheet (pink copy) of the CC/RA form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA form. Receipts of Bills of Lading will be retained as part of the permanent documentation in the project file.

3.3 Sample Custody Within Laboratory

The designated laboratory will assume sample custody upon receipt of the samples and CC/RA form. Sample custody within the analytical laboratory will be the responsibility of designated laboratory personnel. The laboratory will document the transfer of sample custody and receipt by the laboratory by signing the correct portion of the CC/RA form. Upon receipt, the laboratory sample custodian will note the condition of the samples, by checking the following items:

1. Agreement of the number, identification and description of samples received by comparison with the information on the CC/RA form; and
2. Condition of samples (any bottle breakage; leakage, cooler temperature, etc.).

If any problems are discovered, the laboratory sample custodian will note this information on the "Laboratory Comments/Condition of Samples" section of the CC/RA form, and will notify the sampling personnel or Project Manager immediately. The Project Manager will decide on the final disposition of the problem samples.

The laboratory will retain the second sheet (yellow copy) of the CC/RA form and return the first sheet (white original) to originator with the final laboratory report of analytical results. The original of the CC/RA form will be retained as part of the permanent documentation in the project file.

A record of the history of the sample within the laboratory containing sample status and storage location information will be maintained in a logbook, or a computer sample tracking system, at the laboratory. The following information will be recorded for every sample access event:

1. Sample identification;
2. Place of storage;
3. Date(s) and time(s) of sample removal and return to storage;
4. Accessor's name and title;
5. Reason for access; and
6. Comments/observations (if any).

The laboratory will provide a copy of the logbook or computer file information pertaining to a sample upon request.

3.4 Sample Custody During Inter-Laboratory Transfer

If samples must be transferred from one laboratory to another, the same sample custody procedures discussed above will be followed. The designated laboratory person (sample custodian) will complete a CC/RA Record (Figure SOP-2JRS-1 form or similar) and sign as the originator. The laboratory relinquishing the sample custody will retain a copy of the completed form. The laboratory receiving sample custody will sign the form, indicating transfer of custody, retain a copy, and return the original record to originator with the final laboratory report of analytical results. The CC/RA Record will be retained as part of the permanent documentation in the project file.

3.5 Packaging and Shipping Procedure

All sample containers will be properly labeled and all samples will be logged on the Chain-of-Custody Request for Analysis form in accordance with the procedures explained.

All samples will be packed in the cooler so as to minimize the possibility of breakage, cross-contamination and leakage. Before placing the sample containers into the cooler, all sample bottle caps will be checked and tightened if necessary. Bottles made of breakable material (e.g., glass) will also be wrapped in protective material (e.g., bubble wrap, plastic gridding, or foam) prior to placement in the cooler. Each bottle or soil liner will be placed into two zip-lock bags to protect from cross-contamination and to keep the sample labels dry. Sample containers will be placed upright in the cooler. Stacking glass sample bottles directly on top of each other will be avoided.

If required by the method, samples will be preserved to 4°C prior to the analysis. Water ice or "blue ice" will be used to keep the sample temperatures at 4°C. The ice will be placed in two zip-lock bags if the samples are to be transported by someone other than the sampler (e.g., a courier or overnight delivery service). The zip-lock bags of ice will be placed in between and on top of the sample containers so as to maximize the contact between the containers and the bagged ice. If the sampler is transporting the samples to the laboratory shortly after sample collection, the water ice may be poured over and between the sample bottles in the cooler.

If there is any remaining space at the top of the cooler, packing material (e.g., styrofoam pellets or bubble wrap) will be placed to fill the balance of the cooler. After filling the cooler, the top will be closed and the cooler shaken to verify that the contents are secure. Additional packaging material will be added if necessary.

When transport to the laboratory by the sampler is not feasible, sample shipment will occur via courier or overnight express shipping service that guarantees shipment tracking and next morning delivery (e.g., Federal Express Priority Overnight). In this case, the chain-of-custody records will be placed in a zip-lock bag and the bag will be

placed on top of the contents within the cooler. The cooler will be taped shut with packaging tape. Packaging tape will completely encircle the cooler, and a chain-of-custody seal will be signed and placed across the packaging tape, and across at least one of the opening points of the container.

Copies of all shipment records provided by the courier or overnight delivery service will be retained and maintained in the project's file.

3.6 Documentation and Records Management

Daily Field Records or a field notebook with field notes will be kept describing the packaging procedures and the method of shipments. Copies of all shipping records and chain-of-custody records will be retained in the project files.

4.0 QUALITY ASSURANCE

The Project Manager or designated reviewer will check and verify that documentation has been completed and filed per this procedure.

5.0 REFERENCES

49 CFR 173. Shippers – Shippers – General Requirements for Shipping. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>

49 CFR 178. Specifications for Packaging. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>

ASTM D 4220. Standard Practice for Preserving and Transporting Soil Samples. American Society for Testing and Materials available online at <http://www.astm.org/>

ASTM D 4840. Standard Practice for Sampling Chain-of-Custody Procedures. American Society for Testing and Materials available online at <http://www.astm.org/>

COC No. _____

PROJECT NO.: _____ PROJECT NAME: _____ PAGE: _____ OF: _____

SAMPLER (Signature): _____ PROJECT MANAGER: _____ DATE: _____

METHOD OF SHIPMENT: _____ CARRIER/WAYBILL NO.: _____ DESTINATION: _____

SAMPLES													ANALYSIS REQUEST										
		Sample Collection			Preservation				Filtration*	Containers			Constituents/Methods					Handling			Remarks		
Lab No.	Field Sample Identification	DATE	TIME	Matrix*	HCl	HNO ₃	H ₂ SO ₄	COLD		VOLUME (ml/oz)	TYPE*	NO.						HOLD	RUSH	STANDARD			
						TOTAL NUMBER OF CONTAINERS						LABORATORY COMMENTS/CONDITION OF SAMPLES										Cooler Temp:	

RELINQUISHED BY:			DATE	TIME	RECEIVED BY:		
SIGNATURE	PRINTED NAME	COMPANY			SIGNATURE	PRINTED NAME	COMPANY

***KEY:**

DISTRIBUTION: PINK: Field Copy YELLOW: Laboratory Copy WHITE: Return to Originator

Matrix: AQ - aqueous NA - nonaqueous SO - soil SL - sludge P - petroleum A - air OT - other

Filtration: F - filtered U - unfiltered

Containers: P - plastic G - glass T - teflon B - brass OT - other

FIGURE SOP-2 JRS-1. EXAMPLE CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

J. R. SIMPLOT COMPANY – SMOKY CANYON MINE

STANDARD OPERATING PROCEDURE No. 5

WATER QUALITY SAMPLING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during sampling of surface water, stormwater, or wastewater. The procedures presented herein are intended to be general in nature and are applicable when referenced by a monitoring or sampling and analysis plan. Appropriate revisions may be made to accommodate site-specific conditions or project-specific protocols when they are approved in writing by the Project Manager or detailed in a project work plan, sampling plan, or quality assurance project plan.

2.0 BASIS FOR METHODOLOGY

The methods and procedures described in this SOP were developed from these sources:

- U.S. Geological Survey, variously dated. *National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9*. Available online at <http://pubs.water.usgs.gov/twri9A>.
- U.S. Environmental Protection Agency, Region 8, 2003. *SOP EH-#1 Technical Standards Operating Procedure – Surface Water Sampling East Helena Site, Montana*. Available online at http://www.epa.gov/region8/r8risk/pdf/r8-src_eh-01.pdf

3.0 PROCEDURES

3.1 Sample Collection

Individual samples from surface water sampling stations will be collected as follows:

- A. Where multiple sampling stations exist along a moving water source (i.e., a creek or drainage channel), the downstream station will be sampled first. A moving water sample will be taken from the portion of the water with maximum flow at any given sampling station unless otherwise specified. If

the sampling point is inaccessible from shore, the sampling personnel will enter the water from a point downstream of the sampling point, taking care not to disturb the water.

- B. A standing water sample will be taken at a point in the body of water at least three feet from the shore, if possible, or unless otherwise specified.
- C. A surface water sample will be collected according to one of the following, or similar, techniques.
 - 1. Direct Method -- Sample bottle is uncapped and inverted, submerged to the specified depth, turned upright pointing upstream, removed from the water, and then capped. Add preservative, if any, after sample collection.
 - 2. Dipper Method -- Sample bottle or container attached to a pole is dipped in the water, raised above the water, and then capped (if actual sample bottle used).
 - 3. Bailer Method -- A appropriate sampling bailer with a ball check valve is submerged to the desired sample depth, either directly or by suspending the bailer on a rope from a pole.
 - 4. Syringe Method (for very shallow water) -- A disposable plastic filtering syringe may be used to collect very shallow surface water without disturbing the sediment. The syringe will be disposed of after each use.
 - 5. Peristaltic Pump Method -- The sample is collected through a section of new, clean, flexible Tygon (polyvinylchloride) or silicone tubing. The tubing intake will be secured manually or by attaching weights. This procedure may be modified to collect the sample through a Teflon tube into a sample flask by running the pump on a vacuum.
 - 6. Kemmerer Bottle -- Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the upper and lower stoppers are pulled away from the body, allowing water to enter the tube. Lower the pre-set sampling device to the predetermined depth. Avoid disturbing the bottom. Once at the required depth, send the weighted messenger down the suspension line, closing the device. Retrieve the sampler and discharge the first 10-20 mL from the drain to clear water that may not be representative of the sample. Repeat as needed to fill collect the needed volume.
 - 7. Van Dorn Sampler -- Set the device so that the end stoppers are pulled away from the body allowing surface water to enter the tube. Lower the sampler to the predetermined depth. Once at the required depth send the weighted messenger down the suspension line, closing the sampling device. Retrieve the sampler and decant the first 10-20 mL from the drain to clear water that may not be representative of the sample from the valve. Repeat as needed until the required volume to fill sample bottles is collected.

8. Bacon Bomb Sampler -- Lower the bacon bomb sampler carefully to the desired depth, allowing for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taught. This will allow the sampler to fill. Release the trigger line and retrieve the sampler. Decant the first 10-20 mL from the drain to clear water that may not be representative of the sample from the valve. Repeat as needed until the required volume to fill sample bottles is collected.
- D. The first collected water will be used to rinse the sampling equipment. Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling. Subsequent water collected will be used to fill the analytical sample bottles until all bottles are filled. Field measurement of parameters will be taken once for each sampling station at the time of sample collection. Field parameters (pH, specific conductance, temperature, DO, ORP, odor, turbidity, and/or sediment) will be measured from a separate container (instruments will not contact the analytical samples) or directly from the water body sampled.
- E. To mark the exact sampling location, either: (1) a stake or pole identifying the sampling station should be placed at or near the sampling station for future identification of the location, or (2) the sample location will be recorded in a Global Positioning System (GPS) device and coordinates will be downloaded at the end of the field event. Personnel will record a brief description of the stake or pole location in relation to permanent landmarks, and the sampling location in relation to the stake or pole (example: stake is approximately 100 feet west along Markley Creek from Somersville Road, on north-side shore. Sampling point is 25 feet south of stake, in middle of Markley Creek), or the GPS coordinates of the location. Personnel will include a sketch map of the sampling station in the Surface Water Sampling Record (attached form or similar).

3.2 Sample Filtration

When required, a field-filtered water sample will be collected using a disposable, in-line 0.45 μm filter. The water sample will be pumped through the filter using a peristaltic pump and a section of Tygon (polyvinylchloride) or silicone tubing or other appropriate method. An aliquot of approximately 100 ml of sample will be run through the tubing and filter prior to collection into the sampling containers. Both the filter and tubing will be disposed of between samples.

3.3 Sample Containers and Volumes

The sample containers will be appropriate to the analytical method and will be obtained from the water analysis laboratory or other approved source. Different containers will be required for specific groups of analytes in accordance with U.S. EPA Methods, project-specific requirements, and/or other local jurisdictional guidance. The sampler will confirm with the laboratory performing the analyses that appropriate bottlenecks and preservatives are used and ensure that a sufficient volume of sample is collected.

3.4 Sample Preservation and Storage

If required by the project or analytical method, water samples submitted for chemical analysis will be stored at 4°C in ice-cooled, insulated containers immediately after collection. Preservation and storage methods depend on the chemical constituents to be analyzed and should be discussed with the water analysis laboratory prior to sample collection. EPA and/or other local jurisdictional requirements and/or the requirements of a project-specific plan (e.g., sampling and analysis plan, work plan, quality assurance project plan, etc.) shall be adhered to in preservation and storage of water samples.

3.5 Field Measurements

Specific conductance, pH, turbidity, dissolved oxygen (DO), oxidation-reduction potential (ORP) and temperature measurements will be performed on water samples at the time of sample collection. Data obtained from these (or other) field water quality measurements will be recorded on the appropriate sampling records. Separate aliquots of water shall be used to make field measurements (i.e., sample containers for laboratory analysis shall not be reopened).

For surface water sampling, the parameters will be measured once and recorded.

3.5.1 Temperature Measurement

Temperature will be measured directly from the water source or from a separate sample aliquot. Temperature measurements will be made with a mercury-filled thermometer,

bimetallic-element thermometer, multiprobe, or electronic thermistor. All measurements will be recorded in degrees Celsius (°C).

3.5.2 Turbidity

Turbidity will be measured by using a field portable nephelometer capable of reading down to 0.1 NTU. The instrument will be calibrated at least daily prior to initiating field activities and periodically throughout the day or as recommended by the instrument manufacturer. Turbidity measurements will be reported in nephelometric turbidity units (NTU).

3.5.3 pH Measurement

A pH measurement will be made by dipping the probe directly into the water source or into a separate sample aliquot. Prior to measurement, the container in which the field parameter sample will be collected will be acclimated to the approximate temperature of the sample. This can be accomplished by immersing the container in water collected from the sampling location. The pH measurement will be made as soon as possible after collection of the field parameter sample, preferably within a few minutes, using a pH electrode. The value displayed on the calibrated instrument will be recorded after the reading has stabilized. If the value falls outside of the calibrated range, then the pH meter will be recalibrated using the appropriate buffer solutions.

3.5.4 Specific Conductance Measurement

Specific conductance will be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. Specific conductance will be reported in micromhos/cm at 25 °C. If the meter is not equipped with an automatic temperature compensation function, then the field value will be adjusted at a later time using the temperature data and the following formula:

$$SC_{25} = SC_T / [1 + \{(T - 25) \times 0.025\}]$$

where: SC_{25} = specific conductance at 25 °C
 SC_T = specific conductance measured at temperature T (°C)
T = sample temperature (°C)

The value displayed on the calibrated instrument will be recorded after the reading has stabilized. If the value falls outside of the calibrated "range" set by the range dial on the instrument, then the range setting will be changed to a position that gives maximum definition. If the specific conductance value falls outside of the calibrated range of the conductivity standard solution, then the instrument will be recalibrated using the appropriate standard prior to measurement.

3.5.5 Dissolved Oxygen

Dissolved oxygen measurements taken from surface water locations should be representative of the conditions being monitored. For example, if a sample is to be collected from the middle of a stream cross-section, that is also where the DO measurement should be taken.

The dissolved oxygen probe should be fully immersed in the water body being monitored. If the DO measurement is taken from a stream, the probe should be elevated above the stream bed to minimize disturbance of channel sediments. If DO measurements are taken from a water body that is not flowing, the probe should be slowly raised and lowered so that water is moving past the DO probe membrane.

Dissolved oxygen readings should be recorded after allowing sufficient time for the probe to equilibrate and the readings to stabilize. For surface water measurements, the DO reading will typically stabilize as soon as the probe has equilibrated. The value displayed on the calibrated instrument will be recorded after the reading has stabilized.

For further detail, see MFG SOP No. 17, Field Measurement of Dissolved Oxygen.

3.5.6 Oxidation-Reduction Potential

Oxidation-Reduction potential (ORP) will be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. ORP will be reported in mV. Readings should be

recorded after allowing sufficient time for the probe to equilibrate and the readings stabilize.

For further detail, see MFG SOP No. 13, Field Measurement of Oxidation-Reduction Potential.

3.5.7 Equipment Calibration

Equipment used to measure field parameters will be calibrated in the field by personnel according to manufacturer's instructions prior to the collection of any samples. Calibration checks will be performed at least once prior to and at least once following each day of instrument use in the field and the results will be documented on the Sampling Record for each sampling station.

3.6 DOCUMENTATION

Surface Water Sampling Record

Each sampling event for each surface water sampling station will be recorded on a separate Surface Water Sampling Record form (attached form or similar). The documentation should include the following:

- A. Project identification;
- B. Location identification (sampling station);
- C. Sample identification(s) (including quality control samples);
- D. Date and time of sampling;
- E. Description of sampling location;
- F. Sampling depth below water surface;
- G. Sampling method;
- H. Condition of water (standing or moving);
- I. Description of flow measurement method, if applicable, and any flow data;
- J. Instrument calibration and cleaning record;
- K. Results of field measurements and observations (time, temperature, pH, specific conductance, turbidity, sediment, color);
- L. Name(s) of sample collector(s); and

- M. Sketch map showing location of sampling station and permanent landmarks and/or GPS coordinates.

When the sampling activity is completed, the Surface Water Sampling Record will be checked by the Project Manager or his/her designee, and the original record will be placed in the project file.

4.0 QUALITY CONTROL

4.1 Equipment Cleaning

Sample bottles and bottle caps will be cleaned and prepared by the analytical laboratory or their supplier using standard EPA-approved protocols. Sample bottles and bottle caps will be protected from dust or other contamination between time of receipt by the sampling personnel and time of actual usage at the sampling site.

Sampling equipment that will be used at multiple sampling locations will be cleaned after sampling at each location is completed in accordance with the JRS SOP No. 7 (Equipment Decontamination).

Equipment such as submersible electric pumps, which cannot be disassembled for cleaning, will be cleaned by circulating a laboratory-grade, detergent and potable water solution through the assembly, followed by clean potable water from a municipal supply, and then by distilled or deionized water. Equipment cleaning methods will be recorded on the Surface Water Sampling Record.

4.2 Records Review

The Project Manager or designated reviewer will check and verify that documentation has been completed and filed per this procedure.

5.0 REFERENCES

U.S Environmental Protection Agency Region 8, 2003. *Technical Standard Operating Procedure, Surface Water Sampling (SOP #EH-01, East Helen Site, Montana)*. September 2003. Available online at http://www.epa.gov/region8/r8risk/pdf/r8-src_eh-01.pdf

U.S. Geological Survey, variously dated. National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9. Available online at <http://pubs.water.usgs.gov/twri9A>.

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LOCATION ID:

Date: _____ Time: _____ Weather: _____ Page _____ of _____

Weather Past 48 hours: Personnel:

Location Description: _____

Water Body Type:	Water Present (Y/N)	Depth	Flow Meas (Y/N)	Reason if N
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Sampling Equipment: Medium Capacity 0.45 μm filter, Geotech Silicone tubing, Geopump II

Decontamination: Alconox, Distilled Water, Rinse

Method of Sampling: Collect Sample in Disposable (one-time use) container

pH Meter: Model: YSI-556 Calibration: 4.00/7.00 pH Buffers

After Calibration Meter Read:

Conductivity Meter: Model: YSI-556 Calibration: 1,413 $\mu\text{S}/\text{cm}$ Conductivity Standard

After Calibration Meter Read:

Temperature Meter: Model: YSI-556

ORP Meter: Model: YSI-556 Calibration: YSI Zobell Solution

Turbidity Kit: Model: HF Scientific MicroTPW Turbidity Meter; Calibration: _____

Sample Collection Time	Depth (ft)	pH	Specific Conductance (µmhos/cm)	Temp. (°C)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)

Sample Type (circle one): Primary Sample Duplicate Equipment Rinsate Blank

SAMPLE ID: _____

Sample Processing		Container Type	Volume (mL)	Number of Bottles	Filtered	Preservative	Comments
Date	Time						

MAP / COMMENTS **UTM Coordinates (NAD83):**

SIGNATURE: _____

J.R. Simplot Company

SMOKY CANYON MINE

J.R. SIMPLOT COMPANY – SMOKY CANYON MINE
STANDARD OPERATING PROCEDURE No. 6
SURFACE WATER DISCHARGE MEASUREMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol for collecting discharge measurements in streams and ditches. Discharge is defined as the volume rate of flow of water, including any substances suspended or dissolved in the water. Discharge will be expressed in cubic feet per second (cfs) or gallons per minute (gpm). This Standard Operating Procedure provides a method for describing a current and three methods for measuring discharge: 1) volumetric method, 2) area-velocity method, and 3) flume method. Note that the protocol for collection of surface water samples is included in the JRS SOP entitled WATER QUALITY SAMPLING (JRS SOP No. 5).

The procedures presented herein are intended to be general in nature and are applicable when referenced in a monitoring or sampling and analysis plan. As the work progresses, and if warranted, appropriate revisions may be made when approved in writing by the Project Manager.

2.0 BASIS FOR METHODOLOGY

The methods and procedures described in this SOP were developed from these sources:

- Rantz, S.E. et al., 1982. *Measurement and Computation of Streamflow: Volume 1, Measurement of Stage and Discharge*, U.S. Geological Survey Water Supply Paper 2175. U.S. Government Printing Office, Washington, D.C.
- U.S. Department of the Interior, 1977. *National Handbook of Recommended Methods for Water-Data Acquisition*. Office of Water Data Coordination, U.S. Geological Survey, Reston, VA.
- U.S. Environmental Protection Agency, 1986. *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*. Environmental Services Division, Region IV, Athens, GA.

3.0 PROCEDURES

The selection of an appropriate method for discharge measurement depends on the flow conditions. In some conditions, the flow measurement methods described here may be impossible to implement (e.g., extreme high-flow conditions). If flow conditions cannot be measured at a specific location, then field personnel will attempt to measure flow at a point upstream or downstream of the sample site. The field personnel will also note the conditions that inhibited more accurate measurement at the designated measurement location.

3.1 Current Description

In cases where a discharge measurement is not required but a description of the direction and relative rate of flow is useful, the following method for current measurement may be used.

The current within a moving body of water and its direction is variable by location and depth. Current measurement may be used to define the movement of water at a specified location and depth where a sample is collected. Qualitative measurement of current is made by using a strip of soft tape or cloth attached to the end of a pole. The strip will indicate the presence of water flow and direction of flow at the location and depth. The diameter of the pole should be sufficiently small to prevent directional error. Quantitative measurements may be made using a current meter, which determines the water velocity (feet per second) from the revolution of an impeller or from pressure exerted by the water, or one of the other methods described in Section 3.4.

3.2 Discharge Measurement

The selection of discharge measurement method depends on streamflow rate and/or specific channel characteristics. For pipes, drain system outfalls, and cases where flows are too small or stream gradients are too high, the volumetric method is appropriate. In cases where water depth is greater than 0.3 feet or the channel cross section is wide, discharge should be measured using the area-velocity method. Where flows are below the practical limit that can be measured with the area-velocity method, the flume method is best.

Where the total discharge is conveyed through two channels or differing types, a combination of these methods may be appropriate.

3.3 Volumetric Method

The volumetric method is a simple and accurate method for measuring flow from small discharges such as gravity flow discharged from pipe outlets. This method involves observing the time required to fill or partly fill a calibrated container to a known volume. Alternatively, in the case of measuring discharge remotely in a sump or standpipe setting, the volumetric method may be performed by capturing flow in a container for a set period of time, no less than 10 seconds. This volume of water is then measured and discharge is determined.

3.3.1 Equipment

The volumetric method is particularly useful for the measurement of small flows. Equipment required to make this measurement is a calibrated container and a stopwatch. Calibrated containers of varying sizes include: 5-gallon bucket, 2-liter graduated cylinder, 1-liter graduated cylinder, 1-liter bucket, etc.

Extension rods will be used to hold a container for capturing flow in enclosed areas containing discharging pipes.

3.3.2 Maintenance and Calibration Procedures

Graduated cylinders are incremented in terms of milliliters and can be easily converted to gallons. The incremental volume of a 5-gallon bucket can be determined by adding known volumes of water and recording the depth after each addition.

3.3.3 Field Procedures

Upon arrival at the site, the field personnel will evaluate the flow conditions to select the appropriate method for flow measurement. If the flow conditions meet those outlined in Section 3.3, then field personnel will observe and use judgment in approximating the flow volume and will select an appropriately sized volumetric container to use the volumetric method of flow measurement.

A technician will use a stopwatch to measure the time required to fill a volumetric container. The technician will time flow into the container for a minimum of 10 seconds. Five consecutive measurements will be made and noted, and the results will be averaged to determine the discharge.

If remote measurement is necessary, a container will be attached to an extension rod. The technician will time flow for a minimum of 10 seconds. The volume of water will then be poured into a calibrated container, measured, and recorded. Five such measurements will be made, noted, and the results averaged to determine the discharge.

3.3.4 Discharge Calculations

Discharge will be determined initially in gallons per second (gal/s) or in milliliters per second (ml/s). These values will be noted, but the averaged value will be reported in cubic feet per second (cfs). Calculations will be performed as follows:

- Record each of the five measurements in terms of gallons per second or milliliters per second, depending on the volumetric container.
- If one of the five measurements is 50 percent or more different from the other measurements, then this value will not be used. Instead, five additional measurements will be taken and, provided that none of these measurements differs by greater than 50 percent from the other measurements, these values will be used.
- Average the five values.
- Leakage around the discharge pipe, if any, will also be estimated and noted.

- Convert the averaged value to cfs as follows:
 - to convert ml/s to cfs, multiply by 3.53×10^{-5}
 - to convert gal/s to cfs, multiply by 0.134
- Record discharge in cfs.

3.4 Velocity-Area Method

The vertical axis current meter may be used to perform velocity-area method discharge measurements. Common types of vertical axis current meters are the Price meter, type AA, and the Marsh-McBirney. A current meter is an instrument used to measure the velocity of flowing water. Operation of the Price Meter, type AA, is based on the proportionality between the velocity of the water and the resulting angular velocity of the meter rotor. By placing a current meter at a point in a stream and counting the number of revolutions of the rotor during a measured interval of time, the velocity of water at that point is determined. The number of revolutions of the rotor is obtained by an electrical circuit through the contact chamber. Contact points in the chamber are designed to complete an electrical circuit at selected frequencies of revolution. The electrical impulse produces an audible click in a headphone. The intervals during which meter revolutions are counted are timed with a stopwatch. The Marsh-McBirney uses electromagnetic induction to determine the velocity of water. As water flows over a sensor it changes the voltage within the sensor. The changing voltage is processed by the instrument which presents the output as a linear measurement of velocity.

A Price pygmy meter may be used in shallow depths and low-velocity waters. The pygmy meter is scaled two-fifths as large as the type AA meter. The pygmy meter makes one contact (click) per revolution and the type AA meter can make one click per revolution or one click per five revolutions. The Marsh-McBirney type meter can be used at any depth greater than 0.15 feet.

3.4.1 Introduction

The current meter measures velocity at a point. The velocity-area method requires measurement of the mean velocity in selected subsections of the stream cross-section. By dividing the stream width into subsections, discharge becomes the total of discharges measured in each subsection. Velocity (V) is measured at each subsection, and discharge becomes the sum of the products of each velocity point and the cross-sectional area of each subsection:

$$Q = \sum(A_i * V_i)$$

where: Q = Streamflow in cfs,
A = Area of stream subsection in square feet, and
V = velocity in feet per second.

A cross section is defined by the depths at vertical points (i = 1, 2, 3, ...n) where the average velocity is measured.

In general, the person(s) measuring discharge should strive to measure no more than 5 percent of the flow in any one subsection. However, for small streams this is often impossible. Therefore, the person(s) should divide the channel cross-section into as many subsections as possible and make two complete discharge measurements using different sections for each. Subsections do not need to be identical in width. Velocities near banks are generally lower than velocities near the center of streams; therefore, these subsections may be wider than subsections near the center. Subsections will also be more closely spaced if a stream has an unusually deep portion in the cross-section.

Typically, velocities will be measured by current meter for a 40- to 70-second period. It is recognized that 40 to 70 seconds is not long enough to ensure the accuracy of a single-point observation of velocity. However, because pulsations caused by turbulent and eddying effects are random and because velocity observations during a discharge measurement are made at several verticals, there is little likelihood that the pulsations will bias the total measure discharge of a stream.

3.4.2 Required Measurement Conditions

To make an area-velocity discharge measurement, the following conditions are required:

1. The stream must be channelized or contain relatively straight sections upstream of the measurement location.
2. Depth must be greater than 0.2 foot across most of the cross-section being measured.

The ideal channel cross-section is trapezoidal in shape, completely smooth in boundary materials, and possesses a uniform velocity distribution. Such an ideal condition is rarely observed. Therefore, minor modifications to the stream channels will be used to optimize measurement conditions. These modifications may include removal of aquatic vegetation, ice, and moving small stones that impact velocity upstream or downstream of the cross-section. However, no modifications should be made while measurements are being taken.

If flow conditions permit, current meter measurements will be made by wading. The type AA or pygmy meter and the Marsh-McBirney are used for wading measurements. The table below lists the type of meter and velocity method to be used for wading measurements at various depths. The persons(s) should stand at arm's length to the side of the meter.

Velocity Measurement Point Selection

Stream Depth (ft)	Type of Meter	Velocity Measuring Point(s) (Fraction of Depth)
2.5 or more	Type AA/Marsh-McBirney	0.2 and 0.8
1.5 - 2.5	Optional/Marsh-McBirney	0.6
0.3 - 1.5	Optional/Marsh-McBirney	0.6
< 0.3	Pygmy	0.5

Some departure from these specifications will be permitted. A Marsh-McBirney meter is appropriate for all depths deeper than 0.15 feet. Do not switch from one meter to another in the middle of a discharge measurement.

Under open channel laminar flow conditions, the effect of fluid contact with the bed of a stream channel and the air is a vertical distribution of velocities. Consistent with this velocity distribution, actual observation and mathematical theory has demonstrated that a single measurement of velocity taken at 0.6-depth or the average of two point velocities taken at 0.2 and 0.8 of the depth below the surface accurately results in mean velocity in the vertical (U.S.G.S. Water-Supply Paper 2175, 133-134 pp).

If the stream is generally less than 2.5 feet deep, the six-tenths (0.6) method will be used. If the stream is generally greater than 2.5 feet, the two- and eight-tenths (0.2 and 0.8) method, also known as the two-point method, will be used. A complete discussion concerning how to set the wading rod to place the current meter at proper depths is contained in Section 3.4.5, Field Procedures.

In the 0.6-depth method, an observation of velocity made in the vertical at 0.6 of the depth below the surface is used as the mean velocity in the vertical. In the two-point method of measuring velocities, observations are made in each vertical at 0.2 and 0.8 of the depth below the surface. The average of the two observations is taken as the mean velocity in the vertical.

A depth of 1.25 feet will accommodate the 0.6-depth method without causing the meter to be set closer than 0.5 feet from the stream bed; if the meter is set any closer to the stream bed, it will under-register the velocity. If the technician is at a measurement section that has only a few verticals shallower than 1.25 feet, the technician should use the type AA or Marsh-McBirney meter rather than the pygmy meter.

Mechanical vertical axis current meters do not register velocities accurately when placed close to a vertical wall. A Price meter held close to a right-bank vertical wall will under-register because the slower water velocity near the wall strikes the effective (concave) face of the cups. The converse is true at a left-bank vertical wall. (The terms "left bank" and "right bank" designate direction from the center of a stream for an observer facing downstream.) The Price meter also under-registers when positioned close to the water surface or close to the streambed.

3.4.3 Equipment

Current meters, timers, depth and width measuring devices, and a means of counting meter revolutions are needed for measurement of discharge. The equipment includes:

- Top-setting wading rod and current meter;
- Width-measuring devices, either engineer's tape or tagline;
- Digital counter or headset and stopwatch;
- Current meter rating tables;
- Stakes for width-measuring devices; and
- Calculator.

Top-Setting Wading Rod. The depth-measuring device that will be used is the wading rod. The current meter is attached to the wading rod. The top-setting wading rod has a 2-inch hexagonal main rod for measuring depth and a 3/8-inch diameter round rod for setting the position of the current meter.

Current Meter. Vertical axis current meter, Marsh-McBirney, type AA meter, or pygmy meter.

Engineer's Tape or Tagline. Tape measures or premarked taglines are used for stream width measurements. Orientation normal to the flow patterns of the stream and elimination of most of the sag, through support or tension, are recommended for improved accuracy.

Digital Revolution Counter or Headset. The digital revolution counter attaches to an electronic connection at the top of the wading rod. The digital display shows the number of seconds of elapsed time. The person(s) stops the counter after 40 or more seconds, and the counter automatically displays the velocity.

If the digital counters are unavailable, the headset will be used as a means for determining the number of revolutions. A headset attaches to an electronic connection at the upper end

of the wading rod. The person(s) wears this headset to listen to the audible clicking sounds produced by current meter revolutions. The number of rotations are counted and timed. Velocities as a function of time are listed on a current meter rating chart provided by the manufacturer, which is kept in the current-meter carrying case. When using the Marsh-McBirney meter a revolution counter or a headset will not be needed. This type of meter computes velocity directly. A velocity reading should be taken only after a suitable time has passed allowing the readings to stabilize.

Stopwatch. A stopwatch is used to measure time during which velocity is measured at each point in the cross-section.

3.4.4 Maintenance and Calibration Procedures

Prior to and following the use of the current meter, spin tests will be conducted to ensure that the unit performs acceptably. The spin test will be performed in an enclosed area, such as in the cab or in the enclosed rear of the trunk, to prevent wind interference. The test is to be performed prior to attaching the current meter to the wading rod. While holding the meter steady in an area sheltered from breezes, the technicians will spin the rotor and then press the start button on the stopwatch. The technician will observe the meter until the rotor ceases to spin.

The duration of the spin for the pygmy meter will be more than 40 seconds, and for the Price AA meter, it will be more than 90 seconds. If the meter fails to meet the time-of-spin criteria, the meter will be cleaned and oiled before use. If the meter continues to spin well beyond these time limits, the record will indicate that the meter spun for 40+ seconds in the case of the pygmy meter, or for 90+ seconds in the case of the Price AA meter.

The Marsh-McBirney will have a zero check performed on the sensor to ensure accurate readings are obtained. First clean the sensor. Then place the sensor in a five gallon bucket of water. Keep it at least three inches away from the sides and bottom of the bucket. To make sure the water is not moving, wait 10 to 15 minutes after you have positioned the sensor and before taking any zero readings. If needed follow the manufacturer recommendations to zero adjust the sensor.

To ensure reliable observations of velocity, it is necessary that the current meter be kept in good condition. Before and after each discharge measurement, the meter cups or vanes, pivot and bearing, and shaft will be examined for damage, wear, or faulty alignment. During measurements, the meter will be observed periodically when it is out of the water to be sure that the rotor spins freely and/or the sensor is free of debris.

Meters will be cleaned and oiled daily when in use. If measurements are made in sediment-laden water, the meter will be cleaned immediately after each measurement. After oiling, wipe away any excess oil and spin the rotor to ensure that it operates freely. If the rotor stops abruptly, the cause of the trouble will be determined and corrected before using the meter. The Marsh-McBirney should not be oiled in any way.

In addition to meter maintenance, the entire unit consisting of current meter, wading rod, and digital counter or headset will be checked before departure to the field each day as follows:

- Attach the current meter and digital counter/headset to the wading rod.
- Check the digital counter by ensuring that the readout is visible when the unit is turned on.
- If a headset is being used:
 - Spin the current meter to ensure that audible clicks occur.
 - If audible clicks do not occur, the following steps should be taken:
 - Check that electronic connections are tight.
 - Check that the cat's whisker lightly contacts the upper part of the shaft.
 - Spin again. If audible clicks still do not occur, check that the battery in the headset is properly aligned. Replace the battery, if necessary.

3.4.5 Field Procedures

Upon arrival at the site, the field technicians will evaluate the flow conditions to determine which measurement method is appropriate. Based on flow conditions, the Price AA meter, the pygmy meter, or the Marsh-McBirney meter will be selected to perform an area-velocity measurement.

At each measurement point (or section) across the stream cross-section, depth is measured prior to measurement of velocity. Place the wading rod about 0.5 feet downstream from the tagline. Place the wading rod in the stream so the base plate rests on the streambed. The depth of water is read from the graduated main rod. The main rod is graduated into 0.1-foot increments. These increments are indicated by a single score in the metal. Half-foot increments are marked by two scores in the metal, and each foot is marked by three scores in the metal. A vernier scale on the upper handle of the rod corresponds to 0.1-foot increments, and has 1 through 9 in raised numbers next to raised marks. A sliding, adjustable rod, known as the setting rod, to which the meter is attached, has single scored marks that are aligned with values on the vernier scale.

In high-velocity areas, it is recommended that depth be read as the value between depth on the upstream side of the rod and depth on the downstream side of the rod. Depth is measured to the nearest 0.2 foot. This depth is used to set the vertical location of the current meter.

The setting rod is then adjusted downward so that the scored mark of the setting rod that corresponds to the range of depth in feet (e.g., if depth = 0.46, range in feet = 0; or if depth = 1.72, range in feet = 1) is aligned with the stream depth value transposed to the vernier scale. This automatically positions the meter for use in the 0.6 method as the meter is then six-tenths of the total depth from the surface of the water.

For using the two-point method of velocity measurement, the depth of water is divided by 2. This value is set so that the meter will be at the 0.8-depth position from the water surface. The depth of water is then multiplied by two, and this value is set. The meter will then be at the 0.2-depth position measured down from the water surface. These two positions represent the conventional 0.2- and 0.8-depth positions. If depths are less than 0.30 foot,

the 0.5 method may be used. The observation depth recorded will then be 0.5 of the total depth.

If water quality or sediments are sampled in conjunction with discharge measurement, samples will be collected prior to making discharge measurements. The following steps are to be followed in discharge measurement:

- Evaluate the measurement location. Choose a location where flow is least turbulent. If the prescribed location is in a stream reach with highly turbulent flow conditions, try to select a location immediately upstream or downstream. Flow should be visible from bank to bank. Eddies and slack water must not be present. Neither the type AA meter nor the pygmy meter will be used for measuring velocities slower than 0.1 ft/s unless absolutely necessary.
- Remove aquatic vegetation, ice, or other minor flow impediments. When such modifications are made, exercise great care to avoid unnecessary movement of sediments allow flow to stabilize before the current meter measurement begins.
- Position a tape about 1 foot above the surface of the water. Secure the tape so that it remains taut and perpendicular to the channel.
- Select a starting point at either the left bank (left edge of water, LEW) or the right bank (right edge of water, REW). LEW and REW are determined when facing downstream.
- Note the distance in feet, and the stream direction, that this cross-section lies from the prescribed location. For example, the note may read "25 feet downstream" or "15 feet upstream."
- Measure the width of the stream. After selecting the appropriate meter, select the number of subsections in which to measure velocity attempting to measure no more than 10 percent of the total flow in any one section, if possible.
- After determining the distance desired between measuring points, commonly referred to as sections, measurement can begin. Record the time and bank at which measurements start on the discharge measurement notes as "REW Start 0000", using REW or LEW depending upon whether starting at the right or the left edge of the water.
- Note the distance to the beginning edge of water from the initial point. The initial point is an arbitrary point on the tape, preferably zero, which lies on the shoreside of the stream. All station locations are recorded as distances from the initial point.

- Proceed to the first station beyond the edge of water. Record the distance from the initial point on the discharge measurement notes. Place the wading rod into the stream so the base plate rests on the stream bed.
- Stand downstream of the tagline or tape and face upstream. Do not stand behind or close to the meter. Raise the current meter on the wading rod so that it is well above the surface of the water.
- Measure stream depth at the measurement point as indicated on the wading rod. Record the stream depth to the nearest 0.2 foot (for example 0.32 feet or 1.54 feet).
- Lower the meter to the required depth and record the observation depth. The observation depth as a fraction of total depth is 0.6, 0.2, 0.8 or occasionally 0.5.
- The technician will stand in a position that least affects the velocity of the water passing the current meter. That position is usually obtained by facing upstream with the arm fully extended. The technician will stand at about a 45-degree angle downstream from the wading rod. The wading rod is held in a vertical position with the meter parallel to the direction of flow. Avoid standing in the water when possible.
- Start the digital counter. After 40 seconds, stop the counter. Note that the counter reports velocity.
- If using the headset rather than the digital counter, start the stopwatch on the first click and begin counting clicks. The first click counted after starting the stopwatch is counted as one.
- After at least 40 seconds have passed, stop the stopwatch on a click. Record the number of seconds and the number of revolutions (clicks) on the same line of the notes as the recorded depth.
- Determine velocity as a function of elapsed time and number of revolutions from the velocity chart specific to the flow meter. The manufacturer provides these charts with the instrument. Record velocity in the appropriate column. The flow meter must be aligned parallel to the direction of flow.
- Proceed to the next station. Record the distance from the initial point to the station. Repeat measurements of depth and velocity. Continue in this manner across the stream.
- After recording the distance measurement at the last station, record the time at which the ending edge of water is reached (e.g., LEW [or REW] FINISH 1330).
- Note velocity and depth at the edge of water as zero.

- Evaluate and record flow characteristics, weather conditions, air temperature, water temperature, observer(s), type of meter, and remarks.
- If less than 20 subsections have been used for the measurement, repeat the measurement steps. Begin from the opposite bank from where the previous measurement began.

3.4.6 Discharge Calculations

Calculate discharge on the discharge notes as follows:

- Use the distances from initial point to compute width for each subsection. The first width is computed by subtracting the first distance (edge of water) from the second distance and dividing this quantity by two. The second width will be the difference between the third distance and the first distance divided by two. For each subsequent width, subtract the previous station distance from the following station distance and divide this quantity by two. The final width is calculated as the difference between the final distance and the second-to-last distance divided by two. Sum the width column and check to ensure that the calculated width equals the distance between the REW and LEW.
- Multiply the width by the depth for each station to determine the area of each subsection. Sum the areas to determine total area.
- Multiply the velocity by the area for each station to obtain the discharge for each subsection.
- Sum the discharges for each subsection to determine total discharge and record the value.
- If two sets of discharge measurements beginning at opposite banks were taken, repeat the discharge calculations for the second set of data. Average the total discharges for the two measurements. Record the average value and report it for input into the database.

3.5 Control Structures

Control structures, such as flumes, can be used to determine discharge. These structures have regular dimensions that allow for a consistent relationship between water level and discharge. This section describes use of Parshall flumes to measure discharge.

3.5.1 Introduction

A calibrated constriction placed in a stream channel changes the level of the water in or near the constriction. Flumes are constructed so that a restriction in the channel causes the water to accelerate, producing a corresponding change (drop) in the water level. When the physical dimensions of the flume constriction are known, discharge through constriction may be determined from measurement of depth. See below for a description of discharge measurement for Parshall flumes.

Typical flumes consist of three sections:

- A converging section to accelerate the approaching flow.
- A throat section, whose width is used to designate flume size.
- A diverging section, designed to ensure that the level downstream is lower than the level in the converging section.

The stage of a stream is the height of the water surface above an established elevation. Stage is usually expressed in feet. The Parshall flume consists of a converging section with a level floor, a throat section with a downward sloping floor, and a diverging section with an upward sloping floor. The principal feature of the Parshall flume (developed by R. Parshall in 1922) is an approach reach having converging sidewalls and a level floor, the downstream end of which is a critical depth cross-section. The primary stage measurement is made in the approach reach at some standard distance upstream from the critical-depth cross-section.

The flumes are designated by the width (w) of the throat. Flumes having throat widths from 3 inches (in.) to 8 feet (ft.) have a rounded entrance whose floor slope is 25 percent. Smaller and larger flumes do not have that feature.

3.5.2 Required Measurement Conditions

Ideally, flow rate through a flume may be determined by measurements at a single point some distance downstream from the inlet and above the throat.

3.5.3 Equipment

The following equipment will be needed:

- Current meter;
- Carpenter's level;
- Framing square;
- Measuring tapes; and
- Staff gauge.

3.5.4 Maintenance and Calibration Procedures

All flumes will be inspected to determine that entrance conditions provide a uniform influent flow distribution, the converging throat section is level, and that the throat section walls are vertical. The flume will be closely examined to determine that it is discharging freely. Any problems observed during the inspection will be noted and reported to the field manager.

3.5.5 Procedures

Steps to be followed in measuring discharge.

- Remove any material that may have accumulated in the flume or on the weir;
- If the station includes a chart recorder, inspect the strip chart on the recorder to verify that it is operating;

- Note any deterioration of the station; report these conditions to the field manager at the conclusion of daily data collection activities;
- Measure and record the throat width (W) to the nearest 1/10 of an inch;
- Use the staff gauge to measure and record the gauge height (H) to the nearest 0.2 foot;
- Calculate discharge as described in Section 3.5.6; and
- Record the calculated discharge and the time and date of the site visit.

3.5.6 Discharge Calculations

A set of flume tables is necessary for calculating flows. The flume tables are specific to the type and size of flume and are usually supplied by the flume manufacturer. Based on the gage height (head, H, in feet) and the throat width of the flume (size of flume, W), the discharge is read directly from the table provided from the manufacturer. Note that the approximate values of discharge for heads other than those shown may be found by direct interpolation in the table. The following equation and table gives calculation coefficients for discharge calculations with Parshall flumes.

The free-flow discharge equations for the standard Parshall flume sizes are of the form:

$$Q = Ch_a^n$$

where:

h_a = measuring head (ft)

Q = discharge (ft³/s)

C and n = coefficients specific to flume size

Coefficients (C) and exponents (n) for Parshall flume discharge calculations are listed in the following table.

Throat width	Coefficient (C)	Exponent (n)
1 in	0.338	1.55
2 in	0.676	1.55
3 in	0.992	1.55

6 in	2.06	1.58
9 in	3.07	1.53
1 ft	3.95	1.55
2 ft	8.00	1.55
3 ft	12.00	1.57
4 ft	16.00	1.58
5 ft	20.00	1.59
6 ft	24.00	1.59
7 ft	28.00	1.60
8 ft	32.00	1.61
10 ft	39.38	1.60
12 ft	46.75	1.60
15 ft	57.81	1.60
20 ft	76.25	1.60
25 ft	94.69	1.60
30 ft	113.13	1.60
40 ft	150.00	1.60
50 ft	186.88	1.60

3.6 Documentation

Information required by this SOP will be documented in detail in a bound field notebook. This information includes the calibration data for flow measurement devices and field discharge measurement data.

Documentation will also include the type of flow measurement device, including a model number and instrument serial number; a detailed description of measurement location and weather conditions during the measurement; and calculations.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

4.1 Calculation Check

All calculations will be reviewed for accuracy and conformance with these procedures. The calculation review will be performed by a technically qualified individual before results are reported or interpreted. The calculation check shall be documented by the

reviewer's initials and date of review. A copy of the reviewed calculations should be included in the project file.

4.2 Records Review and Management

The project manager or designated reviewer will verify that documentation has been completed and filed per this procedure.

5.0 REFERENCES

Rantz, S.E. et al., 1982. *Measurement and Computation of Streamflow: Volume 1, Measurement of Stage and Discharge*, U.S. Geological Survey Water Supply Paper 2175. U.S. Government Printing Office, Washington, D.C.

U.S. Department of the Interior, 1977. *National Handbook of Recommended Methods for Water-Data Acquisition*. Office of Water Data Coordination, U.S. Geological Survey, Reston, VA.

U.S. Environmental Protection Agency, 1986. *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*. Environmental Services Division, Region IV, Athens, GA.

J.R. SIMPLOT COMPANY – SMOKY CANYON MINE
STANDARD OPERATING PROCEDURE No. 7
EQUIPMENT DECONTAMINATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the methods to be used for the decontamination of all reusable field equipment which could become contaminated during use or during sampling. The equipment may include split spoons, bailers, trowels, shovels, hand augers, or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination between samples and also helps to maintain a clean working environment.

Decontamination is achieved mainly by rinsing with liquids which may include: soap and/or detergent solutions, tap water, distilled weak acid solution, and/or methanol or other solvent. Equipment may be allowed to air dry after being cleaned or may be wiped dry with chemical-free towels or paper towels if immediate re-use is necessary.

At most project sites, decontamination of equipment that is re-used between sampling locations will be accomplished between each sample collection point. Waste produced by decontamination procedures, including waste liquids, solids, rags, gloves, etc., should be collected and disposed of properly, based upon the nature of contamination. Specific details for the handling of decontamination wastes are addressed in the JRS SOP entitled STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK (JRS SOP No. 3) or may be specified by a project plan. These procedures are applicable when referenced in a monitoring or sampling and analysis plan.

2.0 BASIS FOR METHODOLOGY

The methods and procedures described in this SOP were developed from these sources:

- ASTM D5088. Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites. American Society for Testing and Materials available online at <http://www.astm.org/>
- Parker and Ranney, 1997a. Decontaminating Ground Water Sampling Devices, CRREL Special Report 97-25, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.
- Parker and Ranney, 1997b. Decontaminating Materials Used in Ground Water Sampling Devices, CRREL Special Report 97-24, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.

3.0 PROCEDURES

3.1 Responsibilities

It is the responsibility of the field sampling coordinator to ensure that proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of the project safety officer to draft and enforce safety measures that provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Site-Specific Health and Safety Plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that any contaminants are not negligently introduced to the environment.

3.2 Supporting Materials

1. Cleaning liquids: soap and/or detergent solutions (Alconox, etc.), tap water, distilled water, methanol, weak nitric acid solution, etc.

2. Personal protective safety gear as defined in the Site-Specific Health and Safety Plan.
3. Chemical-free towels or paper towels.
4. Disposable, nitrile gloves.
5. Waste storage containers: drums, boxes, plastic bags, etc.
6. Cleaning containers: plastic and/or stainless steel pans and buckets.
7. Cleaning brushes.
8. Aluminum foil.

3.3 Methods

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated. Decontamination procedures should account for the types of contaminants known or suspected to be present. In general, high levels of organic contaminants should include an organic solvent wash step, and high levels of metals contamination should include a weak acid rinse step.

The procedures listed below constitute the full field decontamination procedure. If different or more elaborate procedures are required for a specific project, they may be specified in sampling and analysis or work plan. Such variations in decontamination protocols may include all, part or an expanded scope of the decontamination procedure stated herein.

1. Remove gross contamination from the equipment by dry brushing, and rinse with tap water.
2. Wash with soap or laboratory-grade detergent solution.
3. Rinse with tap water.
4. Rinse with methanol (optional, for equipment potentially contaminated by organic compounds).

5. Rinse with acid solution (optional, for equipment potentially contaminated by metals).
6. Rinse with distilled or deionized water.
7. Repeat entire procedure or any parts of the procedure as necessary.
8. Air dry.

Decontaminated equipment should be stored in sealable containers, such as Ziplock-type plastic bags or cases or boxes with lids.

3.4 DOCUMENTATION

Field notes will be kept describing the decontamination procedures followed. The field notes will be recorded according to procedures described in the JRS SOP entitled FIELD DOCUMENTATION (JRS SOP No. 1).

4.0 QUALITY CONTROL

To assess the adequacy of decontamination procedures, field rinsate blanks may be collected. The specific number of rinsate blanks will be defined in a sampling and analysis or work plan or by the Project Manager. In general, at least one field rinsate blank should be collected per sampling event or per day.

Rinsate blanks with elevated or detected contaminants will be evaluated by the Project Manager, who will relay the results to the site workers. Such results may be indicative of inadequate decontamination procedures that require corrective actions (e.g., retraining).

5.0 REFERENCES

ASTM D5088. Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites. American Society for Testing and Materials available online at <http://www.astm.org/>

Parker and Ranney, 1997a. Decontaminating Ground Water Sampling Devices, CRREL Special Report 97-25, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.

Parker and Ranney, 1997b. Decontaminating Materials Used in Ground Water Sampling Devices, CRREL Special Report 97-24, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.

J.R. SIMPLOT COMPANY – SMOKY CANYON MINE
STANDARD OPERATING PROCEDURE No. 14
SEDIMENT SAMPLING FOR CHEMICAL ANALYSES

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocols to be followed when sediment samples are collected for physical or chemical analysis. The procedures presented herein apply to sediment sampling from surface waters, wetlands, ponds, drainage structures, etc. Procedures identified in this SOP for collection of aquatic sediments from stream settings have also been deemed appropriate for supporting data needs as defined in the Smoky Canyon Mine RI/FS. Appropriate revisions may be made when approved in writing by the Project Manager.

2.0 PROCEDURES

This section describes sediment sampling from the bottom of a surface water drainage course or pond. The collected samples will be placed in appropriate sample containers for transfer to a laboratory for the analyses identified in the Sampling and Analysis Plan. Details of sample collection will be described on the attached sediment sampling form.

2.1 Sampling Equipment and Methods

Sediment in a surface water course with little or no free water may be sampled by directly scooping the sample with a stainless steel or, as appropriate, plastic instrument (e.g., trowel, scoop).

All sediments, including sediment submerged under water, may be sampled by the following methods:

- A. Direct Sampling Method – Submerged sediment may be collected directly using the sample container or scoop. If sampled under water, the container will be capped in place to avoid disturbance while surfacing. If a scoop is used, care should be taken to minimize the loss of fines while lifting the sample from the water.
- B. Manual Core Sampler Method -- A slide-hammer core sampler with stainless steel liners may be used to recover a relatively undisturbed core sample of the sediment. An extension section may be added to reach sediment intervals in deeper waters.
- C. Remote Scoop Method -- A sampling cup or container attached to a pole may be used to collect a sediment sample in deeper water or where a longer reach is needed.
- D. Bottom Sampling Dredge Method -- A sampling dredge attached to a cable also may be used to recover sediment samples in deeper waters.

2.1.1 Stream Sediment Sample Collection

Stream sediment will be collected from the surface to a depth of 4 inches, which is the most biologically active sediment zone in the active channel at each sampling location. Each sample will consist of a mixture, or composite, of five grab samples collected from random locations along the creek channel within 50 feet of the specified location. The five subsamples will be collected from the areas inundated by creek water at the time of sampling. If sufficient sediment is not available from the inundated areas, sediment will be collected from within the active high-flow channel (i.e., no sediments will be collected from overbank areas).

Based on the location conditions, one of the four methods identified above will be used to collect approximately 200 grams of sediment from each subsampling location. If sediment contains a range of grain sizes, then the subsample will be collected to represent the sand-size and finer materials present (i.e., gravel, cobbles and boulders would not be collected). The mass of sediment collected for each subsample used to generate a single composite sample will be approximately the same, and the mass may be estimated by visual assessment of sediment volume.

To create each composite sample, the five subsamples will be placed together in a water-tight plastic bag (e.g., Ziplock or WhirlPack bags). Excess water may be decanted from the sample bag, if necessary, after the five subsamples have been collected and allowed to settle for a short time. If water is decanted, care will be taken to avoid decanting fine sediment at the same time. Any coarse organic debris, such as sticks, leaves or aquatic vegetation, will be selectively removed from the composite sample. Such debris may be removed by hand, using gloves, or with a plastic or stainless steel scoop or spoon. Larger gravels can be removed from the sample using a No. 10 sieve (2 millimeter). This fraction best represents the sands and finer substrate size particles.

The remaining sediment will be thoroughly homogenized within the sealed bag by massaging and rotating the sealed bag for a minimum of 2 minutes or within the sieve pan via stirring. For duplicates, the sample will be split into two aliquots after homogenization, and each aliquot will be placed directly into a new sample bag.

After homogenization, the composite sample will be double bagged, labeled, and placed in a cooler for storage and later shipping (see JRS SOP No. 2).

Sampling equipment will be decontaminated after use at each of the sampling locations in accordance with JRS SOP No. 7, Equipment Decontamination.

2.1.2 Storm Water Detention Pond Sediment Sample Collection

A single composite sediment sample will be collected at each of the storm water detention ponds designated in the Field Sampling Plan. Each sample will consist of a homogeneous mixture of five grab samples collected at different locations within the pond and will include the top 4 inches of sediment encountered at each of those locations.

Sediments collected from dry ponds will be collected using a stainless steel or disposable plastic scoop to remove the top 4 inches of sediment from each subsampling

location. Sediment will be collected from the bottom surface, not from the side slopes, of the pond in areas that would most frequently contain storm water.

If storm water is present at the time of sampling, then procedures for collecting subaqueous sediment cores from a lake or a pond will be adopted. Subaqueous sediment cores will be collected from ponds that contain water. The water in these detention ponds is not expected to be deeper than 3 to 4 feet and may be accessed for sampling by wading. When cores are collected in this manner, the sampler will proceed in a circular direction around the pond to collect the five subsamples and avoid disturbing sediments at the subsampling locations prior to use of the coring device. A core sample will be collected at each subsample location using a Wildco® K-B Corer or similar device. A core barrel long enough to collect 12 inches or more of sample will be used. The core barrel will be advanced a minimum of 6 inches or to the depth of refusal. Clear plastic liners with end caps will be used. Once collected, each sediment core will be capped (with top and bottom marked), labeled and then transported to a clean and flat area for processing into composite samples.

The shallowest 4 inches will be cut away from the core and extruded into a large capacity, water-tight plastic bag for homogenization with the other subsamples from the same pond. Excess water may be decanted from the composite sample bag, if necessary, after the five subsamples have been collected and allowed to settle for a short time. If water is decanted, care must be taken to avoid decanting fine sediment at the same time. Any coarse organic debris, such as sticks, leaves or aquatic vegetation, will be selectively removed from the composite sample. Such debris may be removed by hand, using gloves, or with a plastic or stainless steel scoop or spoon. The remaining sediment will be thoroughly mixed within the sealed bag by massaging the sediment together and rotating the sealed bag for a minimum of 2 minutes. For duplicates, the sample will be split into two aliquots after homogenization, and each aliquot will be placed directly into a new sample bag.

After homogenization, the composite sample will be double bagged, labeled, and placed in a cooler for storage and later shipping (JRS SOP No. 2).

Sampling equipment will be decontaminated between uses at different detention ponds in accordance with procedures in JRS SOP No. 7, Equipment Decontamination.

2.2 Sample Designation

Sediment samples collected in support of the Smoky Canyon Mine RI/FS will be assigned a unique sample number in accordance with procedures identified in the QAPP. Samples will be immediately labeled in the field and sample numbers shall be recorded at the time of sampling in field notes and on the sediment sampling record (attached or similar).

2.3 Sample Preservation

The composited sediment sample will be inspected for color, appearance, and composition, and then sealed in a second plastic bag for storage and transport to the laboratory. The sample will be stored in an ice-cooled, insulated chest at 4 degrees Celsius (+/- 2 degrees) until delivery to the laboratory.

2.4 Sample Handling and Analysis

All sediment samples collected in support of the Smoky Canyon Mine RI/FS will be handled in accordance with the SOP for Sample Custody, Packaging and Shipping (JRS SOP No. 2). Composite sediment samples will be stored on ice in coolers prior to and during shipping.

The laboratory procedure will include producing a representative composite sample by drying and then passing the sample materials through a No. 2 sieve to remove gravel and plant debris and homogenize the remaining sediment if not previously sieved in the field.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

Cleaning procedures will be consistent with the SOP for Decontamination of Field Equipment (JRS SOP No. 7).

When sampling equipment is re-used at different sample locations, the equipment, and any tools used in assembly and disassembly of the equipment, will be cleaned before and after each use; although decontamination between subsampling sites will not be required.

Equipment will be cleaned by scrubbing with a stiff brush using a laboratory-grade detergent/water solution, followed by rinsing with clean, potable, municipal water, then rinsing with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Record Review

The Field Supervisor or designated QA reviewer will check and verify that field documentation has been completed per this procedure and the other procedures referenced herein.

4.0 REFERENCES

MFG, Inc., 2003. Field Sampling Plan for the Smoky Canyon Mine Area A Site Investigation, prepared by MFG, Inc. for the J.R. Simplot Company, Pocatello, Idaho, August 2003.

SAMPLE LOCATION:

Sample Description (color, texture, grain size)

Temperature Meter: YSI-556 Other:

Revision 12/02

J.R. SIMPLOT COMPANY – SMOKY CANYON MINE
STANDARD OPERATING PROCEDURE No. 17
FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the field measurement of dissolved oxygen in water samples. If necessary to accommodate specific field conditions, modifications to the procedure may be made when approved in writing by the Project Manager.

2.0 PROCEDURES

2.1 Explanation of Dissolved Oxygen and Methodology

Dissolved oxygen (DO) refers to the volume of oxygen that is contained in water. Oxygen enters the water by photosynthesis of aquatic biota and by the transfer of oxygen across the air-water interface. The amount of oxygen that can be held by the water depends on the water temperature, salinity, and pressure. Gas solubility increases with decreasing temperature (i.e., colder water holds more oxygen). Gas solubility increases with decreasing salinity (i.e., freshwater holds more oxygen than does saltwater). Both the partial pressure and the degree of saturation of oxygen will change with altitude. Finally, gas solubility decreases as pressure decreases. Thus, the amount of oxygen in water decreases as altitude increases because of the decrease in relative pressure.

Flowing water is more likely to have high dissolved oxygen levels than stagnant water because of the water movement at the air-water interface. In flowing water, oxygen-rich water at the surface is constantly being replaced by water containing less oxygen as a result of turbulence, creating a greater potential for exchange of oxygen across the air-water interface. Because stagnant water undergoes less internal mixing, the upper layer of oxygen-rich water tends to stay at the surface, resulting in lower dissolved oxygen

levels throughout the water column. Oxygen losses readily occur when water temperatures rise, when plants and animals respire, and when microbes aerobically decompose organic matter.

The Membrane Electrode Method (such as that used on the YSI Model 55) is ideal for field dissolved oxygen (DO) testing. Polarographic or galvanic oxygen-sensitive membrane electrodes are composed of two metal electrodes in contact with a supporting electrolyte that is separated from the test solution by a selective membrane. Indicator electrodes are typically made of platinum and reference electrodes are commonly either calomel or Ag/AgCl electrodes with a KCl electrolyte solution. The reference electrode provides a constant electrode potential for comparison to the potential at the platinum electrode. A thin permeable membrane, stretched over the sensor, isolates the electrodes from the environment while allowing gases to enter. When a polarizing voltage is applied to the sensor electrodes oxygen, which has passed through the membrane, reacts at the cathode causing a current flow. The membrane passes oxygen at a rate proportional to the pressure difference across it. Since oxygen is rapidly consumed at the cathode, it can be assumed that the oxygen pressure inside the membrane is zero. Hence, the force causing the oxygen to diffuse through the membrane is proportional to the partial pressure of oxygen outside the membrane. As oxygen partial pressure varies, so does the oxygen diffusion through the membrane. This causes the probe current to change proportionally.

2.2 Instrumentation and Equipment

Typically, obtaining a field DO measurement requires the following equipment:

1. Membrane Electrode-type Dissolved Oxygen meter
2. Platinum indicator electrode and reference electrodes of either calomel or Ag/AgCl
3. KCl reference electrode filling solution
4. Clean (e.g., deionized) water for probe cleaning
5. Squeeze bottle of clean water
6. Membrane/O-ring & KCl kit for probe cleaning and replacement

2.3 Instrument Checks and Calibration

2.3.1 Probe Operation and Precautions

Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than ½ inch dia.) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, replace the membrane and the KCl solution. The average replacement interval is two to four weeks.

1. If the membrane is coated with oxygen consuming material (e.g., bacteria) or oxygen evolving organisms (e.g., algae), erroneous readings may occur.

2. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the probe. If you suspect erroneous readings, it may be necessary to determine if these gases are present.

3. Avoid any environment which contains substances that may attack the probe materials. Examples of some of these substances are concentrated acids, caustics, and strong solvents. Probe materials that come in contact with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the polyurethane cable covering.

4. For correct probe operation, the gold cathode must always be bright. If it is tarnished, which can result from contact with certain gases, or plated with silver, which can result from extended use with a loose or wrinkled membrane, the gold surface must be restored. To restore the cathode you may either return the instrument to the factory, or clean it using a meter-specific reconditioning kit. Never use chemicals or abrasives not supplied with the kits.

5. It is also possible for the silver anode to become contaminated, which will prevent successful calibration. To clean the anode, remove the O-ring and membrane and soak the probe overnight in a 3% ammonium hydroxide solution. Next, rinse the sensor tip and KCl reservoir with deionized water, add new KCl solution, and install a new membrane and O-ring. Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are unable to calibrate, return the instrument to the manufacturer for service.

6. If the sensor O-ring is worn or loose, replace it with an appropriate O-ring.

7. To keep the electrode from drying out, store the probe in the instrument calibration chamber with a small piece of moist towel or sponge.

8. Consult the operations manual of the electrode instrument for the correct, instrument-specific calibration procedure.

2.4 Sample Measurement Procedures

2.4.1 Surface Water Measurements

Dissolved oxygen measurements taken from surface water locations should be representative of the conditions being monitored. For example, if a sample is to be collected from the middle of a stream cross-section, that is also where the DO measurement should be taken.

The dissolved oxygen probe should be fully immersed in the water body being monitored. If the DO measurement is taken from a stream, the probe should be elevated above the stream bed to minimize disturbance of channel sediments. If DO measurements are taken from a water body that is not flowing, the probe should be slowly raised and lowered so that water is moving past the DO probe membrane.

Dissolved oxygen readings should be recorded after allowing sufficient time for the probe to equilibrate and the readings to stabilize. For surface water measurements, the DO reading will typically stabilize as soon as the probe has equilibrated.

2.4.2 Groundwater Measurements

Dissolved oxygen measurements should be taken during well purging and immediately before and after sample acquisition using a direct-reading meter. Because most well purging techniques allow aeration of collected groundwater samples, it is important to minimize potential aeration by taking the following precautions.

- 1) Use a pump to purge the well when possible (a peristaltic pump can be used for groundwater depths of less than approximately 25 feet) to prevent downhole aeration of the sample in wells screened across the water table. Well drawdown should not exceed 5 percent of the height of the standing water column in the well. This drawdown amount may vary with each site. The pump tubing should be immersed alongside the dissolved oxygen probe beneath the water level in the sampling container (i.e., a flow-through cell). This will minimize aeration and keep water flowing past the dissolved oxygen probe's sampling membrane. A maximum low purge flow rate of 200 - 500 mL/minute is typically suggested to minimize aeration, however, this is dependent on site-specific

hydrogeology. If bubbles are observed in the tubing during purging, the flow rate of the pump must be slowed.

2) Although not recommended, a bailer can be used to collect a sample for dissolved oxygen measurements. The problem with this method is that it is very unlikely to provide an undisturbed sample. When using a bailer, the bailer should be slowly immersed in the standing column of water in the well to minimize aeration. After sample collection, the water should be drained from the bottom of the bailer through tubing into the sample container. The tubing used for this operation should be immersed alongside the dissolved oxygen probe beneath the water level in the sampling container. This will minimize aeration and keep water flowing past the DO probe's sampling membrane.

3) Downhole dissolved oxygen probes can be used for dissolved oxygen analysis, but such probes must be thoroughly decontaminated between wells. In some cases, decontamination procedures can be harmful to the dissolved oxygen probe. When taking a downhole DO measurement, the probe should be lowered to the midpoint of the water column and slowly raised and lowered so that water is moving past the probe's sampling membrane.

4) Dissolved oxygen measurements can be used as a stabilizing parameter in conjunction with other indicator parameters (i.e., pH, temperature, conductivity, etc.) to distinguish between formation water and stagnant casing water. Once these parameters have stabilized (typically $\pm 10\%$ for DO) and a minimum of three well casing volumes have been removed, a representative DO measurement can be recorded either from an in-line flow cell or a downhole DO probe. Of the stabilization indicator parameters used above, DO usually requires the longest time for stabilization.

2.5 Documentation

All measurement results should be recorded according to procedures outlined in the SOP titled FIELD DOCUMENTATION. The instrument manufacturer, model number and unique identification number should also be recorded with the measurement data.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Field measurements will be reviewed prior to their use on a project. The project manager or designated reviewer will verify the DO data and also confirm that documentation has been completed per this procedure.

4.0 REFERENCES

EPA, 1995. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.

YSI Inc., 1994. Operations Manual for YSI Model 55 Handheld Dissolved Oxygen System (Membrane Electrode Instrument).